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P3_5 England's Penalty Curse

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Abstract

This article simulates penalty shoot outs based on the England national team's penalty record. It was found that England have an approximate 36% chance of winning a shoot out and could win a tournament just by penalty shoot outs 1 in 242 times.

Introduction

It has become a national joke that whenever the England national football team compete in an international football tournament that they will inevitably lose on penalties. This is due to their somewhat terrible record of winning just 2 out of 9 penalty shoot outs. The penalty shoot out has often been seen as a “luck of the draw” system, this paper takes into account the results of England's penalty shoot out record in an attempt to find out chances of England winning a tournament i.e winning 5 games consecutively with out a loss, just by winning penalty shoot outs.

Method

Both the amount of goals scored by England and their opposition was taken in to account in this investigation. Frequency plots in Figures 1a and 1b represent this [1], and these distributions were used to weight a given number of goals scored or conceded.

A multinomial distribution was then used to model these probabilities. In particular 7 boxes were created, which each represented a number of goals scored, each with corresponding probability as shown in Table 1, for both England and

| No. Goals Scored | Probability (England) | Probability (Opposition) |
|------------------|-----------------------|--------------------------|
| 0 | 0 | 0 |
| 1 | 1/9 | 0 |
| 2 | 1/9 | 1/9 |
| 3 | 1/3 | 2/9 |
| 4 | 2/9 | 4/9 |
| 5 | 2/9 | 0 |
| 6 | 0 | 2/9 |

Table 1: Table showing the probability of England and their opposition scoring a given amount of goals in a game

their opposition. Random numbers were then generated based on the 2 distributions, each of which correlated to a number of goals scored. 9 simulations of 100 numbers each were generated (50 numbers for each team). Subtracting the 2 numbers lead to 3 conditions, an England win $X > 0$, Opposition win $X < 0$ and a draw $X = 0$, X being England goals scored minus opposition goals scored. When a draw was concluded ($X = 0$), the winner was decided by a 50/50 chance in an attempt to simulate a “sudden death” situation. The code was then

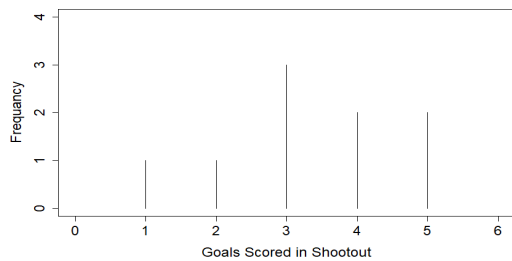


Figure 1a

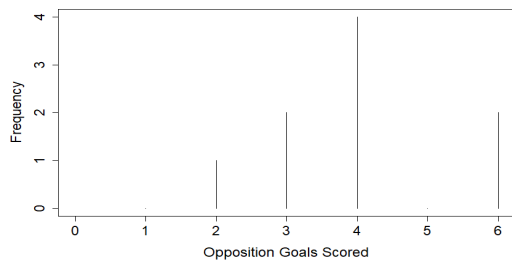


Figure 1b

Figures 1a and 1b: Frequency plots representing a; goals scored by England in penalty shoot outs and b; goals scored by opposition in penalty shoot outs.

altered to simulate England winning the world cup, purely through winning penalty shoot outs. This assumed England qualified for the tournament and made it through the group stages. It was then counted how many iterations of the simulation it would take for England to win 4 times consecutively, representing round of 16, quarter final, semi final, and final. This was repeated 100 times to gain an average value.

Results

Figure 2 represents the results gained. It is obvious that the results are not in England's favour. It was found that in these simulations that England won a total of 325 times whilst the opposition won a total of 575 times, in other words England have an approximately a 36% chance of winning a penalty shoot out. 145 shoot outs went to sudden death, of which England won 77. It was also found that England would

need 242 tournaments to win a tournament just by winning penalty shoot outs. Assuming there's a tournament every 2 years, we therefore would have to wait 484 years for England to be crowned champions of a tournament.

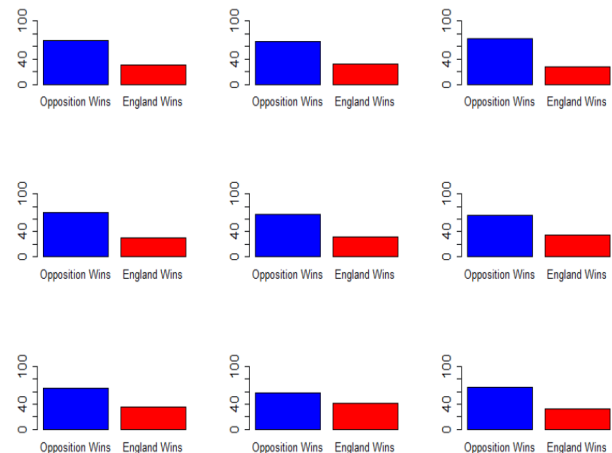


Figure 2: 9 barplots representing 9 simulations of 100 penalty shoot outs.

Discussion

This is a very crude simulation as the sample size of England tournaments is extremely small, being just 9. This also does not count for other significant factors such as the current talent pool of the players in the teams, location of the game, weather conditions etc. It is also very unlikely that 4 consecutive matches would result in a penalty shoot out and has only been treated that way to make the simulation possible.

Conclusion

The simulation created deems chances of England winning a penalty shoot out rather unlikely, at an approximately a 36% chance given England's record. It was also found that it would take 242 tournaments before England would win a tournament purely through penalty shoot outs. This is assuming that England qualify for the tournament and get past the group stages.

References

- [1] <http://www.EnglandFootballOnline.com/TeamPenalty/EngPenKickShootoutMts.html> [Accessed 26 October 2018]